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Conduct of Vehicle Recovery in
The AirLand Battle Future Concept

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A Monograph
by
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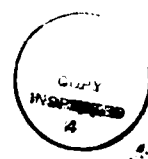
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ABSTRACT

CONDUCT OF VEHICLE RECOVERY IN THE AIRLAND BATTLE FUTURE CONCEPT
by MAJ J.R. Mott JR, USA, 43 pages.

This study conducts an in-depth analysis of the recovery function and applies the results to developing recovery support for the AirLand Battle Future (ALBF) Concept.

First, the monograph introduces the AirLand Battle Future Concept in its latest phase of development. Second, it critically evaluates the current recovery function's ability to support the contemporary force. Next, the study conducts an in-depth analysis of the function itself. A historical perspective is then provided by looking at recovery operations during World War II and the 1973 Arab-Israeli War. Finally, the study analyzes recovery support for the ALBF concept using as criteria the recovery functional analysis and historical perspective. Conclusions and implications are presented in the framework of doctrine, organization, training, materiel, and leader development.

The study concludes that the role of vehicle recovery in the AirLand Battle Future concept will be to support the maneuver and reconstitution of forces. It further concludes that the Army's recovery assets, as currently configured, are deficient to support the concept. Non-linear warfare, as defined by the ALBF concept, accentuates the need for agile, capable recovery in support of highly mobile combat forces. The Army's recovery capability cannot meet this requirement.

Key implications of the study are:

1. Recovery assets should be organized as special units, separate in function from the maintenance units.
2. Improved recovery equipment is needed to support the force on the non-linear battlefield.
3. Training of recovery crews must be improved.
4. A concept of recovery for ALBF is needed.
5. Recovery elements require top-notch leadership.

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I. INTRODUCTION

Vehicle Recovery is a technical and individual function on the battlefield. It serves to remove vehicles from the destructive fire of the enemy and deliver them to a location for repair or further evacuation.¹ The recovery function supports the operational concept of the maneuver force. As that concept changes, the recovery concept adapts to remain compatible in doctrine, organization, training, materiel and leader development.

The United States Army is at a historic doctrinal crossroads. The AirLand Battle Future Study is an ongoing initiative to relook the role of the Army in light of recent global events. It "describes how the Army fights from the tactical to operational level to meet its world-wide commitments."² The study "focuses on the employment of the Army as the land component of the U.S. military power in the 21st century."³ "Emphasis is on maneuver at the corps operational and tactical level. ALBF describes how contingency, forward deployed, and reinforcing forces will fight in conflict and win."⁴ "Warfare will be non-linear and characterized by three simultaneous operations, close, deep, and rear."⁵

The ALBF operational concept contains four phases: detection preparation; establishment of conditions for decisive operations; decisive operations; and reconstitution.⁶ The last two phases are the concern of recovery forces.

Decisive operations is primarily a maneuver phase. The concept assumes a non-linear battlefield for maneuver forces.⁷ Corps units will be dispersed to preclude detection and targeting by enemy weapon systems. The commander commits his forces to achieve "decisive" action at the "critical time and place."⁸ Forces will then disperse to reconstitute and prepare for future action.⁹

"Reconstitution is a term for actions required to restore combat capability to an incapacitated unit."¹⁰ It can be accomplished by reorganization or regeneration. Reorganization "restores combat effectiveness by cross-leveling assets within a unit or forming a composite (smaller) unit at a full or over-strength level."¹¹ Regeneration is "the rebuilding of a unit in which the mission capability has been reduced or degraded."¹²

The AirLand Battle Future study may significantly change the face of combat service support, specifically the recovery function. The nature of highly mobile maneuver on a non-linear battlefield may make support considerably more difficult. The purpose of this study is to determine the role of vehicle recovery in the ALBF concept and suggest the best means for employing recovery assets in support of that concept.

My methodology first looks at recovery in both current doctrine and the ALBF concept. It then analyzes recovery theoretically to establish an in-depth understanding of the subject. This includes the principles of recovery; time-space

relationships; command, control, and communications; equipment and personnel requirements; effects of terrain and weather; and the human dimension. Next, history is analyzed to gain insights on warfare involving heavy mechanized forces. Finally, the study analyzes the recovery function in the ALBF concept. The analysis is based on currently configured recovery support on a non-linear battlefield. Conclusions and implications are developed from the analysis to determine the best means for employing recovery assets in support of the emerging concept.

II. CURRENT RECOVERY DOCTRINE

Current doctrine requires units to recover their own disabled vehicles. Using units under the current tables of organization and equipment (TO&E) are "organized, staffed, and equipped" to do this.¹³ "Recovery operations in armor and mechanized infantry units are centrally managed at the battalion level, usually under the Battalion Motor Officer."¹⁴ The J series TO&E facilitates this by consolidating company maintenance assets and Recovery Vehicles (RVs) into the battalion maintenance platoon. "The company will have a company maintenance team attached to provide automotive, turret, and communications-electronics maintenance and recovery."¹⁵ Each team will have its own RV, the crew consisting of team mechanics. Battalion maintenance will have additional RVs that may or may not be sent forward depending on the tactical situation.

Direct support maintenance units also have limited assets to recover their organic vehicles, support the brigade support (BSA)/division support area (DSA) and provide backup to the unit maintenance platoons.¹⁶

First attempts at recovery are initiated by the operator or crew of the disabled vehicle using on-board equipment.¹⁷ Failing that, the company commander may designate a 'like' vehicle to conduct recovery operations. The tactical situation may preclude this and a recovery vehicle will be requested from the unit maintenance team.

The immediate objective of any recovery mission is to remove the vehicle from enemy direct fire. It will then be recovered to the unit maintenance collection point (UMCP) or a designated maintenance collection point (MCP).¹⁸ During offensive operations, the fast pace of advancing units requires recovery equipment to bring disabled equipment to predesignated collection points along the axis of advance, preferably the main supply route (MSR).¹⁹ Recovery during defensive operations is more difficult. Removal of vehicles from enemy fire will be a dangerous business. Current RVs are not equipped with internally controlled hook-up devices, requiring RV teams to dismount and prepare the disabled vehicle for towing. Speed is an important factor. Routes and alternate routes to and from the defensive positions must be gauged for resistance before combat begins.²⁰ Communications is essential to coordinate the operation.

Other resources besides RVs may be considered for recovery operations. These include like vehicles or vehicles with non-repairable weapons systems.²¹ A tank with a non-repairable main gun is an example of a vehicle that can still be used effectively for recovery.

In addition to U.S. equipment, captured foreign materiel may also need removal from the battlefield. Disposition instructions "are provided through intelligence channels."²² This is a mission that tasks the unit for time and equipment resources beyond its normal requirements.

III. THE MAINTENANCE AND RECOVERY CONCEPT FOR ALBF²³

A concept for recovery is not specifically addressed in the ALBF concept. It is encompassed in the maintenance function, as it is in current doctrine. The Battlefield Maintenance System is the concept being developed to support the ALBF. "Under the Battlefield Maintenance System, all maintenance except basic operator and crew tasks will be performed by a maintenance unit within the forward support battalion."²⁴ This is a radical departure from today's organization for support which provides a unit level of maintenance.

The proposed system does not address a concept for recovery. The changes made in maintenance, however, will have a direct effect on how recovery is conducted. Elimination of maneuver unit maintenance elements includes their RVs and crews.²⁵ Recovery

of maneuver battalion vehicles will now be conducted by a forward support maintenance company (FSCM). It is notionally configured with five RVs.²⁶ Maneuver companies will be supported by company maintenance teams (CMTs) task organized from the FSCM.²⁷ The CMT will have limited recovery capability.²⁸ Recovery is still considered part of the maintenance function. RV crews are still recruited from the mechanic ranks, though reintroduction of the recovery specialist MOS 63R is being studied.²⁹

Chapter VI analyses the role of the recovery function in the ALBF concept. The effects of the new maintenance system will be addressed at that time.

IV. THE RECOVERY FUNCTION

This chapter provides an understanding of the recovery function in terms of imperatives; equipment and personnel requirements; effects of terrain and weather; the human dimension; battlefield friction; and command, control and communication. Unless specifically cited, the information presented is original thought developed from experience and observation in the maintenance field from 1977 to date.

RECOVERY IMPERATIVES

An imperative is defined by Webster's Dictionary as something that is "absolutely necessary." Recovery is a technical function

operating in the totally unpredictable environment of the battlefield. There are imperatives that are absolutely necessary for its success. They can also serve in academia as a reference for understanding. The imperatives listed below have been developed by this study. They are specifically oriented to recovery and supplement the sustainment imperatives in FM 100-5.³⁰ These imperatives are presented, not as a list for future recitation, but as a means for better understanding the subject.

Positioning. The positioning of recovery elements reflects the nature of the battlefield activity. In the offense, recovery elements will follow the attacking forces. RVs are less likely to encounter enemy activity. Speed of recovery and repair, however, is important in supporting the offensive momentum. During defensive operations, recovery elements must be positioned adjacent to the fighting forces to ensure expeditious removal of damaged vehicles from the area of enemy fire. Finally, a retrograde requires careful positioning of recovery elements to support the scheme of maneuver and to collect the largest number of vehicles possible.

Mobility. Recovery elements must be capable of operating in multiple environments, for example rough terrain, swamps, deserts, snow, high heat, wet weather, etc. Speed is a direct benefit of enhanced mobility, and critical to recovery operations. Vehicles

must be removed from the area of enemy fire rapidly and transported to a position where they can be repaired. Greater speed buys time which translates into more missions for the recovery team.

Capability. Overcoming resistance is the essence of recovery operations. Resistance is "any opposing force that prevents movement."³¹ Recovery vehicles need the capability to apply an equal or greater force to overcome the resistance of the disabled vehicle. To do this, the RV requires sufficient power or the ability to apply a mechanical advantage. For example, a 63 ton tank is mired in mud at fender depth. The resistance to be overcome is 126 tons.³² A recovery vehicle must be capable of applying at least 126 tons of force to overcome the resistance and recover the vehicle.

Training. As in any technical skill, recovery requires a great deal of education and experience. Operators must know their equipment, methods of recovery, the nature of the vehicle to be recovered, and the basic soldier skills for their survival on the battlefield.

Control. The volume of disabled vehicles on the next battlefield will be considerable. Control of the finite number of recovery assets to service the requirement is essential. A priority of work must be adhered to which conforms to the commander's intent.

At the same time, assets must be properly positioned to facilitate responsive, efficient support.

Communication. Maneuver and recovery elements require a method of communication that transmits the location and general condition of disabled vehicles. RV teams must be able to work independently while staying informed of the tactical situation.

Protection. Recovery crews must be able to access the main battle area. This requires a degree of protection from indirect and direct fires and the ability to provide their own suppressive direct fires.

CONCLUSIONS: IMPERATIVES

A concept for recovery to support ALBF must satisfy the recovery imperatives. If not, a significant shortfall in capability to meet the maneuver commander's requirements will occur.

RECOVERY EQUIPMENT AND PERSONNEL REQUIREMENTS

Vehicle recovery is a unique technical function. As such, it requires special equipment and soldiers with special skills. Recovery equipment must meet four criteria; compatibility, versatility, durability, and survivability.

First recovery equipment must be compatible with the type of equipment it supports. The RV requires sufficient capability to

support its customers in the areas of towing, winching, and lifting.³³ As an example, on hard, dry, and even ground, the M88A1 recovery vehicle "exerts a force equal to its own weight."³⁴ To tow a disabled M60A1 tank with a load resistance of 53 tons will require a recovery vehicle capable of applying 53 tons of effort.³⁵ The M88A1 RV is capable of towing such a tank. A 63 ton M1A1, however, is beyond the normal towing capacity of the M88A1. The two are not compatible. Two M88A1's or winch operations may be required.

The second criteria is versatility. Recovery equipment must be able to negotiate severe terrain and weather. It will be required to tow its load through ice, mud, water and sand. It must also be able to climb and descend any terrain its customer goes and return with its customer in tow.

The third criteria is durability. The army recognizes three quality specifications for fielding new equipment; reliability, availability and maintainability (RAM). At the tactical level, this translates to durability; the performing of redundant missions with a high mean time between failures. RVs that require a great deal of maintenance will limit the number of vehicles retrieved, repaired, and returned to the fight. A lack of equipment durability will also have a significant impact on the energies and morale of the RV crew members. Vehicle maintenance/repair can be exhausting work, tiring a crew before they can perform their mission. Additionally, crewmen that lack confidence in their equipment are less likely to take the initiative.

The final equipment criteria is survivability. Recovery operations require the rescue of disabled vehicles from the close battle. Recovery teams must be equipped to operate in an environment that provides protection against direct, indirect and NBC weapons systems.

Trained, disciplined recovery personnel are every bit as essential to the mission as their equipment. Technology that cannot be manipulated by the soldier is mute, and recovery is a technically oriented business. The German Army of World War II understood the challenges of the recovery specialist:

The demands made upon the tank recovery platoon are manifold; its personnel, therefore, must consist of men who combine good soldierly qualities with technical knowledge.³⁶

A recovery specialist requires an extensive education to become proficient in his field. His training requirements address four areas: basic soldier skills, operation of assigned equipment, equipment diagnosis and repair, and recovery operations.

Army Field Manual 20-22, Vehicle Recovery Operations, states: "Once recovery equipment operators/crews have been identified, they must be trained and skilled in the following tasks:

1. Assist in security against opposing forces during recovery operations.
2. Execute recovery operations to limit damage to equipment.
3. Use map reading and land navigation to locate and retrieve disabled equipment.
4. Use basic issue items (BII) and other available equipment to aid in recovery.³⁷
5. Use appropriate manuals and secure-voice communications equipment.
6. Employ smoke as needed in recovery operations
7. Operate in mission oriented protective posture (MOPP) in a nuclear, biological, chemical (NBC) environment and decontaminate equipment.

8. Use oxyacetylene for cutting operations, as needed, to aid recovery

9. Use winches, booms, block and tackle, anchors and mechanical advantage to effect recovery.³⁸

To this must be added the operator's primary military occupational specialty (PMOS), normally automotive mechanic. PMOS training generates a list of required skills in itself. For brevity purposes, it will be referred to as PMOS.

Another skill not listed in FM 20-22 is battle damage assessment (BDA). This is an essential task for the recovery specialist. Upon arrival at the recovery site, he must determine the extent of damage to the disabled vehicle. His analysis dictates to what location the vehicle is to be recovered. Slightly damaged equipment is repaired at unit level. Seriously damaged equipment will be evacuated farther to the rear. This task may also be performed by the unit maintenance team, depending on the tactical situation.

The following chart tracks the skills required of recovery operators against the four areas of training (type skill): basic soldier, skills, equipment operator, mechanic, and recovery operations.

<u>SKILL</u>	<u>REQUIRED AREA OF TRAINING (TYPE SKILL)</u>			
	BASIC SOLDIER	EQUIPMT OPERATOR	MECHANIC	RECOVERY OPNS
Security Operations	X			
Rec Operations		X		X
Map Reading	X			
Land Navigation (Maneuver)	X			
Use BII (example M88A1)		X		
Crew Served Wpns		X		
Use Manuals			X	X
Use Commo	X	X		
Employ Smoke		X		X
NBC Defense	X			
Use oxycetylene		X		X
Use Winches, Tackle, Mech. Advantage		X		X
Battle Damage Assessment			X	X
PMOS, e.g. Auto Mech.			X	

Two key observations can be made from the chart. First, a great deal of specialized training is needed to be a recovery specialist. He is a vehicle operator, a mechanic, an expert in recovery operations, and a soldier who operates both a personal and crew served weapon. Second, the chart shows how the mechanic and recovery skills differ. This is significant because the U.S. Army considers both skills interchangeable. The implication is that the recovery specialist can do it all. In reality, he is given an unreasonable task. Recovery and mechanic primary skills are mutually exclusive. An education in one discipline will not qualify the other. Additionally, being proficient in automotive maintenance is not required to perform maintenance tasks. Recovery specialists will require training in battle damage assessment, but should not require a mechanic education.

CONCLUSIONS: EQUIPMENT AND PERSONNEL REQUIREMENTS

Three conclusions are made for recovery equipment personnel. First, vehicle recovery is a stand alone function on the battlefield. Second, recovery equipment and design must incorporate the qualities of compatibility, versatility, durability, and survivability. Finally, recovery personnel have a special training requirement that is independent of the maintenance function. They should be specially trained to perform this task, not detailed from the mechanic ranks.

EFFECTS OF TERRAIN AND WEATHER

Conditions of terrain and weather can be the greatest enemy on the battlefield for recovery operations. Three critical factors are influenced by them: access, tow capacity and human performance.

Access is defined as the "way or means of approaching" the recovery site.³⁹ It is made more difficult if the terrain is uneven or the weather has worsened the conditions of the terrain. Mud, snow and ice severely restrict the movement of heavy RVs. The M88A1 in particular has very limited traction with its rubber padded track.

Access serves only to get to the recovery site. The real challenge is to retrieve the disabled vehicle. An RV's normal towing capacity is reduced considerably in rough terrain and further reduced when that terrain is complicated with mud, rain or ice. It has already been stated in this study that the towing

capacity of the M88A1 RV is rated inadequate for the 63 ton M1A1 tank. On flat, dry ground, the M88A1 can normally get the job done. If the ground is uneven or slippery, however, more than one RV is required. Even the 53 ton M60A1 tank is a challenge for the M88A1 when weather and terrain are difficult.

Finally, the effect of extreme weather on human performance must be considered in recovery operations. The workload of the RV crew will be degraded during extreme temperatures and severe weather.

CONCLUSION: TERRAIN AND WEATHER

An understanding of vehicle recovery must include the degradation of capability imposed by terrain and weather. Terrain conditions effect access to the site, RV towing capacity and human performance. If these factors are not considered, a significant shortfall of capability on the battlefield may occur.

HUMAN DIMENSION OF VEHICLE RECOVERY

Planners of military operations tend to dwell on quantifiable issues. They often develop force ratios based on units and unit equipment capabilities. For example, the lethality of a tank battalion might be gauged by the quality of its weapons. If it has the most effective gun, the highest velocity round, state-of-the-art optics, and impenetrable armor, it is considered lethal. The materiel aspect of that unit, however, is only a percentage of its value. Often overlooked is the importance of

the personnel in the equation. If poorly led, trained or disciplined, a soldier's equipment will have little impact against a well prepared and enthusiastic enemy. Carl von Clausewitz wrote: "If no one had the right to give his views on military operations except when he is frozen, or faint from heat and thirst, or depressed from privation and fatigue, objective and accurate views would even be rarer than they are."⁴⁰

Understanding the human dimension of recovery operations is important to the military planner. The recovery operator has a stand alone mission. His anticipated workload in the next battle will keep him awake for long periods of time, deprive him of comfort, and subject him to the dangers of combat. Fatigue, stress, sickness, and injury will thin his ranks. Allocation charts that plot the number of hours required to conduct missions will be useless unless they generously account for those elements that degrade his effort.

In developing force structure, doctrine, training, and materiel for recovery operations, the human dimension must be considered. For example, a doctrine that locates recovery assets far from the combat units has injected increased travel time for the RV to reach the down site. The crew will be more fatigued and will have less time to meet the next mission. Inadequate training, force structure and materiel will further erode personnel effectiveness. As a minimum, mission accomplishment will be jeopardized. More serious is the possibility of personnel loss.

CONCLUSIONS: THE HUMAN DIMENSION

The human dimension must be considered in recovery operations. Development of force structure, doctrine, training, and materiel should support the soldier to enhance his survival and accomplishment of his mission.

BATTLEFIELD FRICTION AND RECOVERY

Everything in war is very simple, but the simplest thing is difficult. The difficulties accumulate and end by producing a kind of friction that is inconceivable unless one has experienced war.

Carl von Clausewitz⁴¹

Clausewitz's concept of friction portrays the innumerable things that go wrong between a concept of military operations and its execution. A simple task fails to get accomplished because an unforeseen obstacle lays in its path. Friction, is "the force that makes the apparently easy so difficult."⁴²

Someone who has not experienced the complexities of vehicle recovery will find it difficult to perceive how this evidently simple task can become so difficult.⁴² A veteran recovery specialist, however, has seen how human error, terrain and weather, equipment failure, injuries and enemy activity can create an inordinate amount of friction. Doctrine and force designers can take several steps to reduce the effects of friction. Practiced and experienced leaders can be provided for the RV crews. This combined with effective crew training will decrease the instances of human error and increase competence. Dependable, capable equipment will allow the crew to perform their mission

without a materiel constraint. Finally, valid doctrine will provide the ways and means for support to the maneuver force.

CONCLUSION: FRICTION

Friction plays a significant role in the recovery force's ability to support the concept of maneuver. Recovery doctrine and force structure must be oriented to reducing the effects of friction through good leadership, trained crews, capable equipment and effective doctrine.

RECOVERY COMMAND, CONTROL AND COMMUNICATIONS

C³ of recovery operations is essential for success. The mission is difficult, time is critical, and recovery assets are limited. Who commands recovery? What is the best utility of the limited assets? Should they be consolidated in a central location under a logistician or be distributed among customer units? The answer must support the commander's concept of maneuver.

For command purposes, it is best to plan and organize centralized and execute decentralized. This allows the logistician to weight the support effort to reflect the commander's intent.

The location of assets needs to facilitate control while meeting mission requirements. Obviously, the closer an element is to the headquarters, the easier it is to control it. If HQ, however, is too far away from the element's intended objective, mission accomplishment will suffer. Control of recovery assets is

particularly difficult. Time and distance to and from the disabled vehicle must be overcome. It is done in an environment that may involve difficult terrain, weather, and hostile forces. The workload may be greater than the capability which will put considerable strain on men and equipment. The one factor that cannot be controlled is the location of the disabled vehicle. What can be addressed is where the recovery assets and their control element are positioned to meet the mission.

There are four possibilities for control of recovery assets at battalion level. First, all RVs may be assigned down to the companies. This increases responsiveness because of their proximity to their customers but disallows flexibility by the battalion headquarters to weight the support effort. A second method is to retain control of all RVs at battalion and respond to individual recovery requirements. This increases control and flexibility at battalion, but also increases distance and response time to the customer. A third method is for battalion to retain initial control of all RV assets, distributing them as the mission requires. This allows weighting of the support effort and pushes RVs forward to the companies as needed. Finally, RVs may be assigned to both the company and battalion level, facilitating in-depth, proximate and flexible support. This method assumes the availability of sufficient assets to field both the company and battalion level.

Control of recovery operations can also be retained at the brigade or even division level. Precedent for this is the German

Army of World War II, discussed extensively in the following chapter. Such a high level of control makes rapid response unlikely and restricts recovery operations to policing the battlefield after fighting has ceased. Control at this level makes sense when assets are few or when companies/battalions are moving too fast to conduct recovery operations.

Three communications must be in effect to make recovery work. First, good communications must exist between the disabled vehicle and its command element. The disabled vehicle can then notify its command of its location and disposition. Second, communications are needed between the command element and the support command element. The command can thus request recovery support for its "downed" vehicle. Finally, effective communications is needed between the support command element and the recovery crew. A fourth communication, between recovery crew and disabled vehicle, improves operations but is not essential.

CONCLUSION: C³

Command, control, and communications should drive the force design of recovery for the AirLand Battle Future concept. First, the commander requires a capability that supports his concept of maneuver. Control must recognize the need for in-depth, proximate and flexible support while meeting the constraints of force structure. Finally, communications must be in effect to make the concept of recovery executable. C³ will be incorporated into chapter IV (analysis) to determine optimal support.

V. HISTORICAL EXAMPLES OF VEHICLE RECOVERY INVOLVING HEAVY ARMORED FORCES

Historical examples of vehicle recovery provide valuable insight for recovery concept development. World War II and the 1973 Arab-Israeli War saw huge mechanized battles with large equipment losses on both sides. The German, American and Israeli Armies were selected for this study because it was evident they placed more emphasis on recovery than did others. How they dealt with their materiel losses on the battlefield provides empirical lessons for a solution to recovery support in the ALBF concept.

GERMAN ARMY RECOVERY OPERATIONS, WORLD WAR II

The method of recovery used by the German army in World War II provides great insight to ALBF concept development. Their entire logistics system was rebuilt from the ground up during five years of intense combat.⁴³ Recovery doctrine was a flexible response to lessons learned in the face of limited resources and significant requirements. The ALBF concept faces a similar challenge.

The German army entered World War II with a very austere tactical logistics system.⁴⁴ Offensives were predicted to be short term after which logistics could be performed at leisure. The offensives in France and Poland supported this way of thinking.⁴⁵ The Russian campaign did not. By 1944, the

Wehrmacht had completely redesigned its logistics force structure to provide long term, responsive support to the tactical maneuver units.⁴⁶

The war on the eastern front focused on economy of logistics.⁴⁷ Long lines of communications and poor transportation systems in Russia forced units to do best with what they had. Regeneration of combat power through recovery and repair of equipment was critical.

The German army's definition of recovery was the "freeing of tanks which have been bogged down and stuck and the removal of tanks which are in need of maintenance or have been knocked out by enemy action."⁴⁸

The basic principle of German recovery operations was to make it a branch of the maintenance service responsible to the maneuver unit.

Efforts to set up tank recovery as a separate organization, operating independently of the tank regiments, failed to meet with success. Since tank recovery on the battlefield is very closely connected with the tactical movements of the troops, it seems advisable to have it carried out by the tank units themselves.⁴⁹

Recovery units were established with one mission in mind, the retrieval of equipment. Armies had recovery companies and regiments had recovery platoons. The Germans did not find it beneficial to divide the recovery vehicles among the battalions.⁵⁰ A typical platoon consisted of 1 officer, 6 NCO's and 23 enlisted men mounted on 1 car and 12 recovery vehicles.⁵¹

Maintenance teams had a different mission. They would follow the combat elements, repair disabled vehicles if possible, prepare nonrepairable vehicles for towing, report its location and drive on.⁵² The recovery teams would then respond to the requirements established by the maintenance teams. These would normally be prioritized by the regimental technical services officer.

The Germans found that any recovered tank could serve a purpose, no matter how damaged and made great efforts to police the battlefields. "Cases in which it does not pay to attempt to recover disabled tanks are extremely rare in actual practice."⁵³ If the vehicle could not be returned to action, it could still be used for parts.

Recovery elements were organized under larger maintenance organizations, however they worked independently to perform their tasks. The Germans concluded "only very reliable non-commissioned officers and men, therefore, can be employed in the recovery platoon."⁵⁴ It was normally "commanded by an extremely resourceful officer with both technical and tactical training."⁵⁵

CONCLUSIONS: GERMAN ARMY, WORLD WAR II

The German's long lines of logistics in Russia demonstrated the need for economical logistics. This included efficient recovery and repair of damaged equipment by the maneuver unit. Although recovery units came under larger maintenance organizations, they had a stand alone-mission and operated independently.

This configuration facilitated flexible response to the brigade or higher maneuver commander. The recovery crews had to be well trained and disciplined to operate in this manner. Finally, the Germans learned that all disabled equipment had a recoverable value.

AMERICAN RECOVERY OPERATIONS IN NORTH AFRICA, WWII

Between Sbeitla and Kasserine Pass, an Ordnance heavy wrecker was proceeding swiftly down the road on a recovery mission. Suddenly, there was a roar accompanied by the chatter of multiple machine guns and the crash of bullets through metal, wood and glass...None of the personnel were casualties, but the wrecker was fiercely ablaze. A Messerschmitt had scored.⁵⁵

The North African campaign provides an excellent example of recovery and maintenance support on the non-linear battlefield. Cited below are excerpts from LTC W.C. Farmer's article, "Ordnance on the Battlefield: Supply and maintenance in the North Africa Campaign," "Ordnance Magazine," September-October 1944. His article explains the challenges of fighting in a non-linear, desert environment. Especially useful is his explanation of where ordnance (maintenance) elements operated in relation to their customers. A second key observation was the need to conduct support operations at night to preclude detection.

In the winter of 1942-1943, troops of the American II corps were engaged in heavy fighting with the Panzer divisions of Rommel's Afrika Korps. The terrain was, for the most part, wide open, and the front was very broad... There was no 'front line' and terrain that was traversable by armored and mechanized equipment stretched out on the flanks for a distance of from fifty to one hundred miles.⁵⁶

In order to provide Ordnance support, it was necessary to attach Ordnance troops directly to the combat teams and to have them operate in proximity to these troops which were engaging the enemy. One ordnance collection point and repair park was in plain view of enemy installations... The Germans had air superiority because their airfields were closer to the scene of combat, and therefore it was practically impossible to operate Ordnance recovery or supply on the roads during daylight hours. Both recovery and supply had to be performed at night, and although it minimized danger of air attack, it increased the threat from enemy patrols and mine fields.⁵⁷

Many people visualize a so called 'front line' as being some sort of line upon which troops are arrayed in battle order facing the enemy. They imagine that it would be impossible to pass beyond it without recognizing it as such. This is generally not true. It is very difficult to realize when you have passed the most forward positions.... Time and again Ordnance personnel in this war (including the writer) have been rather abruptly faced with the enemy much to our surprise, and discomfiture...due to the wide-open employment of troops. Too much cannot be said on the subject of Ordnance and other supporting troops keeping abreast of the local tactical situations.⁵⁸

When the battle is over, the combat troops have some time to rest and rehabilitate themselves. This is not true of Ordnance troops. Recovery, salvage, reclamation, maintenance and supply must continue in order to get the guns and equipment back in shape for the next battle.⁵⁹

CONCLUSION: AMERICAN OPERATIONS IN NORTH AFRICA, WORLD WAR II

Non-linearity on the battlefield poses special challenges for the logistician. First, LTC Farmer recognized the danger to the logistics elements when they were not in proximity of a combat element. Non-linearity cannot guarantee security outside of that sphere. Second, logisticians must stay abreast of the tactical situation if they are to move support to units established on a

non-linear battlefield. Tactical training down to the crew becomes critical. These two points are especially pertinent for recovery elements which are often dispatched to work missions independently. C³ must be sufficient to provide centralized management and decentralized execution.

ISRAELI RECOVERY OPERATIONS DURING THE 1973 WAR

The 1973 war is an excellent platform for studying vehicle recovery on the non-linear battlefield. The Israeli's linear border defenses were penetrated in the first two days of the war by the Egyptians in the Suez and the Syrians in the Golan. For the next three weeks, the war was a series of individual attacks and counterattacks within a greater operational framework. Battle was primarily a clash of armored forces resulting in large materiel and personnel losses for both sides. Three thousand tanks were destroyed, a horrific number for the short duration of combat.⁶⁰

The Israeli's recovery effort was essential to success. There were three sources of war materiel reinforcement for the army.⁶¹ First was the U.S. emergency airlift. The second source was captured enemy materiel and the third was repaired Israeli equipment. U.S. assistance did not begin arriving until 14 Oct (D+8), emphasizing the importance of maintenance and repair of existing resources. The Israelis were successful in regenerating materiel strength through battlefield repair until the supply system became effective.

Nearly every Israeli tank was hit during the war, but most of them were repaired - the majority in the course of fighting - and ultimately only some 400 of our tanks and twenty-five artillery pieces were wiped off the books.⁶²

The Israelis used two methods of vehicle recovery. First, combat units conducted like-vehicle recovery with their organic tanks. Second, ordnance units recovered vehicles from points behind the combat elements.

Discussion of like vehicle recovery is important because it differs from the U.S. doctrinal use of RVs as a primary means. An example of like vehicle recovery was Kahalini's battalion (IDF) on the Golan Heights, 9 October: "The first tanks to go towed with them damaged comrades, both to evacuate the wounded and to enable restoration of the vehicles."⁶³ Another example is Adini's Battalion (IDF) fighting in the Suez, 8 October, Cpt. Ze'ira commanding: "Six (Israeli) tanks were burning, totally destroyed, with crewmen running about. Ze'ira evacuated the casualties and helped tow some of the other disabled tanks."⁶⁴

The towing of disabled tanks with serviceable ones was operating procedure and rescue of vehicles from an advancing enemy depended on it. Commanders removed large numbers of damaged vehicles to the rear where maintenance teams were waiting. There were two limitations. First, serviceable tanks were required to tow damaged ones. Second, the tactical situation had to facilitate it. Often, commanders were forced to move their units, precluding recovery of their disabled tanks. Amir's tank battalion had such an experience in the Suez: "By evening he had

eighteen Centurions and seven Pattons, of which only seven had originally gone into action with him. He had abandoned thirteen tanks near Mifreket."⁶⁵

A number of issues arise with the use of like vehicle recovery. First, it removes combat power from the firing line. Second, it adds a burden to the combat crew tasked to tow. Third, it puts a strain on the automotive system of the towing tank. The most important consideration is the dependency on like vehicle recovery to work. If the tactical situation is not conducive, it cannot be performed.

A shell hit Carmis tank, but only three men were seen to get out. Daniel Wahnum, the driver, was trapped inside. The flaps over his head wouldn't open--and the fire in the rear compartment was getting worse. Finally, with a superhuman effort, Daniel forced his way out, but was pinned on the ground by artillery fire. The company commander brought his tank close to Carmi's exposing himself to the Syrian who had done the damage, then leaned out and down to help Daniel up. A shell knocked Yair back into the turret. Daniel, seeing him die, jumped down and ran, screaming, westward, towards our line.⁶⁶

On the positive side, like vehicle recovery is a method to quickly remove large numbers of vehicles when sufficient RVs are not available.

Another observation from the war was the Egyptian and Syrian's limitless Soviet resourcing of the Egyptian and Syrian armies. Within months of the cease fire, both armies replenished their tank losses and, in the case of Egypt, exceeded her original strength.⁶⁷ This underscores the criticality of Israel's own regenerative capability.

Finally, a morale issue involving recovery became evident. gunfire that damaged a vehicle often wounded or killed its crew. Failure to recover the vehicle sometimes meant abandoning the victims as well.

"The casualties on board the APC told Alex that Zeilig, their commander, was still lying dead in his tank. Alex radioed Eitan for permission to go and get him, but was told to wait till the bombardment slackened off. The truth was none of us was happy about leaving the tank out there."⁶⁸

CONCLUSIONS: 1973 ARAB-ISRAELI WAR

Regeneration of combat power through recovery and repair of disabled vehicles was essential to an Israeli victory in 1973. The Israeli Army used like vehicle recovery extensively to remove disabled vehicles from the front lines. In this they were largely successful. Like vehicle recovery best facilitates removal of large numbers of vehicles from the engagement area, however, it severely tasks the combat force. It was conducted by the Israelis primarily after the fighting had ceased and was possible because they normally retained the ground they had fought over. In the event of a withdrawal under pressure, a commander would have to sacrifice combat systems to save his disabled systems from falling into enemy hands. This is the limitation of like vehicle recovery. It forfeits strength in the near term to regenerate strength in the future.

The Israeli war also demonstrated the moral implication of vehicle recovery when casualties are on-board. Expeditious removal of the wounded and dead on the battlefield is important to unit morale and confidence.

VI. ANALYSIS OF RECOVERY FUNCTION IN THE ALBF CONCEPT

Recovery will be critical in the ALBF concept for two of the four phases, maneuver and reconstitution.⁷³ In the maneuver phase, units will be initially dispersed in a non-linear configuration to preclude detection. The Corps commander detects, then engages the enemy with long range fires. Maneuver forces are next committed to converge at the decisive time and place to defeat the enemy.

To move combat forces from dispersed locations to the battle area requires high speed mobility and momentum. Recovery elements can serve to decrease the risk of high speed movement and reinforce that momentum. At high speed, heavy mechanized forces will lose vehicles to mechanical failure and accidents. The Israelis experienced this in the 1973 war:

"Vardi's tank threw one of its tracks, and soon after, the other tank under Choder also lost a track. Both commanders went on foot to look for other tanks to carry out the mission."⁷⁴

(Amir Yoffre's Tank Battalion, IDF, moving to attack an Egyptian bridge site on the Suez Canal, 1973)

In a non-linear battlefield, vehicles lost in movement will be at high risk if left behind as the lines of communication will not be secure. They may also impede route trafficability at choke points, e.g. bridge sites, rough terrain, and built-up areas. To ensure the survivability of vehicles lost to movement, integrated recovery assets can sweep the routes to return the down vehicles

to mobility or tow them to a maintenance site for repair.

Responsive support at this point provides the maneuver commander with a maximum number of weapon systems at his destination.

Once at the decisive time and place, maneuver forces will engage the enemy. Recovery vehicles need to be located in abundant numbers to remove damaged vehicles from enemy direct fire. Many will only be mobility kills. Their crews may survive and choose to continue fighting. Left within range of enemy direct fire, however, mobility kills may take additional hits and be catastrophically destroyed.⁷⁵ Mobility kills, if recovered quickly, can be repaired and put back in the fight. This saves the vehicle and may also save the crew.

The final phase of ALBF combat is reconstitution and recovery. Following decisive action, corps units will disperse again to a non-linear posture, reconstitute and prepare for the next mission. Again the recovery function is critical. Maneuver elements will leave behind damaged and inoperable equipment. Speed of recovery is essential for the protection of the recovery assets themselves. Maintaining a line of communication between the old battlefield and the new dispersed locations will not be possible for any length of time. Recovery assets must be capable of policing the battlefield and staying in contact with the combat elements. If they cannot, materiel will be abandoned.

Combat elements moving to their new dispersed locations will require additional RVs to sweep their routes. Once at their destinations, reconstitution will take place to prepare for the

next mission. RVs will be needed to move damaged materiel and assist in heavy lift requirements. RV assets and their crews will also need to reconstitute for the future.

In review, recovery will have a significant impact in the maneuver and reconstitution/recovery phases of the ALBF concept. First, recovery elements will be required to support the movement of dispersed units as they move to engage the enemy. Second, they will remove disabled vehicles during or immediately after the battle. Third, they will recover the maneuver units to their new dispersed locations. Finally, recovery will be needed to assist in the reconstitution and recovery effort.

VII. STUDY CONCLUSIONS AND IMPLICATIONS

CONCLUSIONS

The role of heavy vehicle recovery in the AirLand Battle Future concept will be to support the maneuver, combat and reconstitution of tactical forces on the non-linear battlefield. The concept poses significant challenges for the recovery function. First, rapid movement of dispersed maneuver units on the non-linear battlefield increases the need for responsive recovery support. Second, the non-linear battlefield dictates that secure lines of communications/support can only be expected within the protective sphere of combat units. RVs must complete their missions quickly so as to keep pace with the maneuver units.

Third, non-linear warfare emphasizes economy of logistics to include efficient recovery and repair of damaged equipment. Recovery of disabled vehicles is a key to near-term force regeneration. Combat damaged systems must be recovered quickly to preclude catastrophic damage by enemy fire. Self recovery, like vehicle and recovery vehicles will still be valid means of retrieving equipment from the battlefield. Self and like vehicle recovery will become necessary to save the large volume of disabled vehicles anticipated in future battles. The cost of using like vehicle recovery is a temporary loss of unit strength and must be considered if planned for in lieu of RVs.

Recovery has moral implications as it assists the expeditious evacuation of wounded/killed crewmen from battle damaged vehicles. If RVs are to be used to retrieve disabled during combat, they must be constructed to do so. If disabled vehicles and their wounded are abandoned until firing ceases, a negative effect on morale can be expected.

Recovery needs to be recognized as a stand-alone function in the ALBF concept. As such, doctrine, organization, training, materiel and leadership development should be focused towards fielding a capability adequate to meet the battlefield requirement.

IMPLICATIONS FOR DOCTRINE AND FORCE DEVELOPERS

Given the role of recovery assets in the ALBF and an in-depth understanding of the recovery function, the following implications can be made:

DOCTRINE

Positioning of RV assets will be critical in ALBF. Recovery vehicles must be far forward to complete their mission in time. They must be integrated with the combat elements as they move to the battle area. RVs must be close enough to the FLOT to rescue mobility kills from catastrophic damage. Finally, they must complete their battlefield requirement in time to support combat as they move to their next dispersed location.

Recovery assets are required at both the organizational and support level. The maneuver commander requires a command relationship with the assets expected to operate in his area of operations. Ad hoc assets forwarded to his AO 'as required' will not meet his needs. Reliable, timely response is critical.

Centralized control and decentralized execution is necessary. Limited RV assets must be judiciously assigned missions. Once dispatched, however, they must be capable of independently accomplishing the mission.

ORGANIZATION

Vehicle recovery is a stand-alone function and should be organized as such. For command and control purposes, it should be aligned under the maintenance function, but should not lose its identity as it has under current doctrine. Recovery assets should be organized and maneuvered as platoons. Recovery personnel should be specially trained, not task organized from existing mechanic assets as per FM 20-22.

Finally, recovery assets should be fielded in sufficient number to meet the anticipated requirements of the battlefield.

TRAINING

RV crews will have to be exceptionally well trained on the future battlefield. This includes a greater emphasis on maneuver skills and self protection. They will have innumerable missions amid a hostile, fluid environment with limited time to accomplish the mission. The primary military occupational skill (PMOS) of an RV crew member should be recovery specialist. Additional training requirements should be vehicle qualification, individual/crew served weapons qualification, basic soldier skills and physical conditioning. Automotive mechanic training should be provide as a secondary MOS or as an orientation.

Non-linear warfare will place greater emphasis on recovery tactics, crew drills, land navigation and communications. Recognition of recovery as an independent function will provide the atmosphere and organization for this type of training.

MATERIEL

RVs must be capable of overcoming the resistance of the disabled vehicles they support on the ALBF. They must also be able to tow vehicles through any terrain the combat elements go. The Army's current RVs fleet requires improved towing capacity for the M1A1. Their speed is also insufficient. ALBF emphasizes rapid movement of forces. The M88A1 cannot keep pace with the M1A1 tank or the M2/M3 Bradley Fighting Vehicle. Speed also factors heavily into the number of missions an RV can accomplish and affects its survivability. The use of the M88A1 severely limits the number of missions that can be performed daily.

A remote hook-up device is needed for RVs. This will save the RV crews from having to dismount to prepare the vehicle from towing. The device makes recovery operations in combat more feasible and aids the evacuation of wounded tank crew members as well as their vehicles.

Recovery vehicles require an NBC protection system. Again, they must be able to operate in the same environment as their customers. This is particularly true if RVs are to be operating with the forward units.

LEADER DEVELOPMENT

Vehicle recovery requires good leaders who can work independently in an exhausting, sometimes hazardous environment. The German Army in World War II understood the challenges of recovery specialists:

"The nature of its work often makes it necessary for individual machines to be away for several days on a mission, when they are withdrawn from the direct supervision of the company. Only very reliable noncommissioned officers and men, therefore, can be employed in the recovery platoon."⁷⁶

Two key actions are necessary to generate good leadership in the recovery ranks. First, RV assets and their crews should be organized into platoons. This provides platoon level leadership positions similar to the combat arms. It also provides a structure for upward mobility opportunities to the rank of Sergeant First Class. Leaders will be generated within the recovery field versus the current system of detailing maintenance NCOs. Leaders will increase their experience and knowledge as they advance in rank. Their retention in the recovery field will provide the younger crew members a leader and mentor with the needed technical skills.

A second requirement is focused recovery training for leaders and their subordinates. This includes a specific military occupational specialty (MOS) for the recovery field. A formal, tracked education for leaders will facilitate the tactical and technical competency crucial to the mission. A parallel education for subordinates will develop future leaders.

ENDNOTES

1. Recovery of unserviceable and abandoned equipment is conducted within the forward support area. Evacuation is the removal of nonrepairable equipment from forward support areas. Items may be nonrepairable due to catastrophic damage, lack of spare parts or repair time constraints.
2. "AirLand Battle Future-The Concept" referred to as "The Newspaper" (Ft. Leavenworth, Combined Arms Center, August, 1990), p1.
3. "The Newspaper," p3.
4. "Concept Statement for Battlefield Maintenance," (Aberdeen Proving Grounds: USOC&S, 10 Feb, 1990), p1.
5. Ibid.
6. "The Newspaper," p6.
7. The Newspaper," p4. Nonlinear Battlefield is defined as "A battlefield upon which the commander, either by choice or the lack of maneuver forces to cover all the terrain, has placed his forces in dispersed, noncontinuous areas from which he can operate to destroy enemy forces within his area of operation."
8. Ibid.
9. Ibid.
10. FM 63-2-2 Combat Service Support Operations: Armored, Mechanized, & Motorized Divisions, (Washington, D.C.: HQ Department of the Army, October, 1986), p2-14.
11. FM 63-2-2, p2-14.
12. Ibid, p2-15.
13. FM 43-12 Division Maintenance Operations, (Washington, D.C.: HQ Department of the Army, April, 1986), p5-1.
14. FM 43-12, p5-1.
15. FM 71-1J The Tank and Mechanized Infantry Team, Coordinating Draft, (Fort Monroe: HQ, TRADOC, December 1985), p8-2.
16. FM 43-12, p5-1.
17. Ibid, p5-2.
18. Ibid, p5-3.

19. Ibid.
20. Ibid.
21. FM 43-17, p5-3.
22. Ibid.
23. "Concept for Battlefield Maintenance System" (Aberdeen Proving Ground: USAOC&S, 6 March 1990), p1.
24. Ibid, p2.
25. Ibid, p3.
26. Ibid, pB-4.
27. Ibid, pB-5.
28. Ibid.
29. Howard Bramblett. Briefing: "Concept for Battlefield Maintenance System" (Aberdeen Proving Ground: USAOC&S, 6 March 1990) slide no. 39.
30. Sustainment imperatives cited in FM 100-5 Operations are anticipation, integration, continuity, responsiveness, and improvisation (Washington, D.C.: HQ Department of the Army, 5 May, 1986) p62-63.
31. FM 20-22, Vehicle Recovery Operations (Washington, D.C.: HQ Department of the Army, August 1984) p37.
32. Ibid, p42.
33. Ibid, p17.
34. Ibid, p50.
35. FM 20-22, P37. "Resistance can simply be defined as any opposing force that prevents movement."
36. Burkhart-Hillebrand, The Tank Repair Serviced In The German Army, Project #27, MSP-040 (Koenigstein: Historical Division, European Command-US, 1 March 1951) p165.
37. As an example, an M88A1 RV driver must be trained in the operation and maintenance of that vehicle. This includes the automotive system, auxiliary power unit (APU), main winch, boom winch, smoke generation system and auxiliary refuel/defuel system. In addition, he must be able to fight the crew served M2 machine gun.

38. FM 20-22, p9-10.

39. Webster's New World Dictionary, ed. Victoria Neufeldt
(Cleveland: Webster's New World, 1986) p7.

40. Carl von Clausewitz, On War, ed. and trans, Michael Howard and
Peter Paret (Princeton: Princeton Univ. Press, 1967) p115.

41. Ibid, p120.

42. Ibid, P119-120.

43. Burkhart-Hillebrand, p9.

44. Ibid, p1-2.

45. Ibid, p12.

46. Ibid, p19.

47. Ibid, p9.

48. Ibid, p73.

49. Ibid.

50. Ibid, p167.

51. Ibid, p119.

52. Ibid, p78.

53. Ibid, p110.

54. Ibid, p95.

55. Ibid, p95.

56. LTC W.C. Farmer, "Ordnance on the Battlefield: Supply and
Maintenance in the North African Campaign," Ordnance Magazine,
September-October, 1944, Vol XXVII, No 14, p207.

56. Ibid, p298.

57. Ibid.

58. Ibid.

59. Ibid.

60. Abraham Adan, On the Banks of the Suez. (Presidio Press, 1980) p466.
61. Ibid, p443
62. Ibid, p442.
63. Avigdor Kahalani, The Heights of Courage, (Westport: Greenwood Press, 1944) p120.
64. Abraham Adan, On the Banks of the Suez. (Presidio Press, 1980) p136.
65. Ibid, p40.
66. Avigdor Kahalani, The Heights of Courage, (Westport: Greenwood Press, 1944) p66.
67. Chaim Herzog, The War of Atonement (Boston: Little, Brown and Co., 1975), p442.
68. Avigdor Kahalani, The Heights of Courage, (Westport: Greenwood Press, 1944) p.
69. "AirLand Battle Future-The Concept" referred to as "The Newspaper" Combined Arms Center, Ft. Leavenworth, August, 1990, p3.
70. "Concept Statement for Battlefield Maintenance," USOC&S, 10 Feb, 1990, p1.
71. Ibid.
72. "The Newspaper," p6.
73. ALBF concept major areas are enemy detection, long range fires engagement, maneuver and reconstitution and recovery.
74. Abraham Adan, The Banks of the Suez, p27.
75. Catastrophic kill is defined by this study as equipment that cannot be repaired and returned to duty.
76. Project #27 European Command, p165.

BIBLIOGRAPHY:

Books/Articles

- Adan, Abraham (Bren). On the Banks of the Suez. Presidio Press, 1980.
- Clausewitz, Carl von. On War. ed. and trans, Michael Howard and Peter Paret. Princeton: Princeton University, 1976.
- Eshel, David, Israel's Armor in Action. Hod Hashoron, Israel: Eshel-Dramit Ltd., 1978.
- Farmer, W.C. "Ordnance on the Battlefield: Supply and Maintenance in the North African Campaign." Army Ordnance Magazine, Vol XXVII No. 14, Sep-Oct 1944.
- Herzog, Chaim. The War of Atonement. Boston: Little, Brown and Company, 1975.
- Huston, John A. The Sinews of War: Army Logistics 1775-1953. Washington, D.C.: U.S. Government Printing Office, 1970.
- Kahalani, Avigdor. The Heights of Courage. Westport, Conn: Greenwood Press, 1944.
- Makers of Modern Strategy, ed. Peter Paret. Princeton: Princeton University, 1986.
- Van Crewald, Martin L. Military Lessons from the Yom Kippur War. Beverly Hills, CA: Sage Publications, 1975.
- Webster's New World Dictionary. ed. Victoria Newfeldt. Cleveland: Webster's New World, 1986.

Reports

- "AirLand Battle Future - The Concept" (Draft), Ft. Leavenworth, Kansas: Combined Arms Command, 1990.
- "AirLand Battle Future Umbrella Concept." Fort Leavenworth, Ks: Combined Arms Command, 1990.
- "Battlefield Vehicle Recovery Study." Aberdeen Proving Ground, Md: USAOC&S, 10 Feb 1990.
- Bramblett, Howard. Briefing: "Concept for Battlefield Maintenance System." Aberdeen Proving Ground, Md.: USAOC&S, 6 March 1990.
- Burkhart Mueller-Hillebrand. The Tank Repair Service in the German Army, Project #27, MSP-040, Koenigstein: Historical Division, European Command (US), 1 March 1951.

"Combat Service Support Battlefield Functional Mission Area Concept." Ft. Lee, Virginia: USALOGC, 1990

"Concept Statement for Battle Maintenance." Aberdeen Proving Ground, Md.: USAOC&S, 10 Feb 90.

German Tank Strength and Loss Statistics. Historical Division, European Command. MS# P-059, 9 June 1950.

Nauta, Frans, "Fix forward: A Comparison of the Army's Requirements and Capabilities for Forward Support Maintenance." Logistics Management Institute, Washington, D.C., April 1983.

Manuals

ARTEP 17-236-10 MTP (Coord Draft), Armor Battalion Maintenance Platoon ARTEP Mission Training Plan. Fort Knox: U.S. Army Armor School, February, 1987.

Field Manual 20-22, Vehicle Recovery Operations. Washington, D.C.: HQ Department of the Army, July 1970.

Field Manual 20-22, Vehicle Recovery Operations. Washington, D.C.: HQ Department of the Army, July 1984.

Field Manual 63-2-2, Combat Service Support Operations - Armored, Mechanized, & Motorized Divisions. Washington D.C.: HQ Department of the Army, October 1986.

Field Manual 63-2, Combat Service Support Operations-Division. Washington, D.C.: HQ Department of the Army, April 1985.

Field Manual 43-12, Division Maintenance Operations. Washington, D.C.: HQ Department of the Army, April 1985.

Field Manual 71-1J, The Tank and Mechanized Infantry Team. Coordinating Draft, HQ, TRADOC, December, 1985.

Field Manual 43-12, Division Maintenance Operations. Washington, D.C.: HQ Department of the Army, April, 1986.